THE USE OF THE General Planisphere, CALLED THE Analemma,

In the Resolution of some of the Chief and most useful PROBLEMS of ASTRONOMY.

LIBRARY

By Dr. *John Twysden.*

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The EPISTLE

TO THE

READER.

Courteous Reader,

I Did not think to have appeared any more in the World in a Subject of this Nature, being now far declined in Years; and in that regard, more fit to have employed the ſhort Remains of my now languiſhing Taper in ſuch Meditations as might make me ready to appear before that Tribunal, where thoſe who ſhall be thought Worthy, ſhall know the truth of theſe things, not by Diſcourſe and Connexion of Con-

ſequences, but by that Intuition which ſhall proceed from the Author of all Cauſes and Things, even God himſelf.

But the Deſire of Friends hath over-ruled my own Inclinations, and prevailed with me to preſent to thy View and Peruſal theſe enſuing Treatiſes. *The firſt contains the Uſes of the* Analemma, *an Old Inſtrument, but in my Judgment, a very good one, and by which moſt* Problems *in the Solution of Plain or Spherical Triangles, are Reſolved with great Facility, and without much cumber or uſe of Compaſſes. 'Tis an Inſtrument eaſily made, there being only the great* Meridian, *which is a* Circle, *the other* Meridians *are* Ellipſes, *which by* Elliptical Compaſſes *fitly placed, may be as eaſily and truely drawn as Circles are with a Beam or Bow; the other are all ſtreight Lines, and divided Sinically. I have one newly drawn by me by Hand, upon a Board paſted over with Paſtboard, between nine or ten Inches Diameter, which I have made uſe of in the Solution of many* Aſtronomical Problems, *with as much*

much Accuracy as can be expected from an Inſtrument of that ſize. Let not any man believe that I go about here to commend the Uſe of Inſtruments any way to ſtand in Competion with the natural way of Computation by the Canon, *but only as Aſſiſtants to thoſe, who being ingaged in great Computations, may eaſily commit an Errour, which an Inſtrument well made will ſoon diſcover. I ſhall not deſcribe the manner of making it, that being ſufficiently done by many others. Mr.* Blagrave *in his* Mathematical Jewel *finds fault, that the* Meridians *towards the* Noon-Line *are very narrow and cloſe together. 'Tis true, they are ſo, the manner of this* Projection of the Sphere *requiring it: but to compenſate this, the Reader may conſider, that the Hour-Spaces farther from the* Meridian, *enlarge themſelves where his grow narrower: nay, where they are broadeſt, the* Parallels *in the* Mater, *and* Almicanters *in the* Rete *will ſometimes run in the ſame Line, ſo that it will be troubleſome to find the* Meridian you deſire. *I would not be thought*

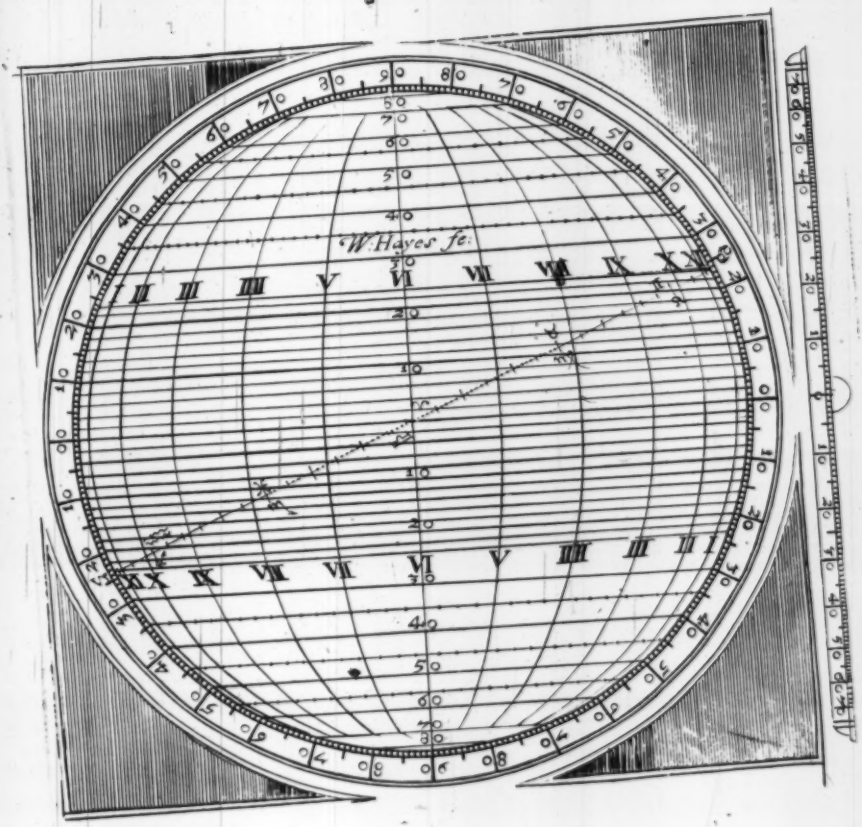
thought to ſpeak this in the leaſt manner to leſſen the Honour of Mr. Blagrave *in his moſt excellent Invention of applying a* Rete *to the* Mater *of* Gemm-Friſeus *his Aſtrolabe; by which Addition the* Triangle *lyes open to your eye, or the careful Embelliſhing, I ſhould rather ſay, new Moulding, or Framing it, by my very Learned Friend, and Skilful* Mathematician *Mr.* John Palmer, Rector *of* Ecton, *and* Arch-Deacon *of* Northampton. *But to ſhew the Difficulty in the making it, where beſides the cutting out the* Rete, *the* Circles *muſt exactly agree to one another, or elſe the Inſtrument will be of little Value; which to obſerve, will require a greater Care than you will eaſily perſwade a Workman to take. I have lately had two made for me in* Braſs, *of about eight Inches Diamiter, the one an* Analemma, *the other* Blagrave's Jewel, *both very well made by my very good Friend Mr.* Walter Hays, *who doth employ and direct the beſt, or as good Workmen as any are, to perform what his Age or Infirmity makes him unable to perform with his own Hands. In this*

this he is much to be commended, that you will very ſeldom find him out of Doors, and to be ſought in Ale-Houſes *or* Taverns, *where many a good Workman ſpends much of his time. The Uſes now given thee, were by me applyed to this Inſtrument many years ſince, when I was at* Paris, *about the Year* 1645, *which hath made me in ſome of the Examples make uſe of the Elevation of the Pole of that Place. Many others I have applyed to other Latitudes, becauſe by various Examples the Precepts will, I think, be made more eaſie. I have added two other* Tractates, *the one called,* The Planetary Inſtrument, *by which the Places of all the Planets, except the Moon, may be eaſily found out, and ſooner than the Place of any one of them can be found out by the Tables. The other is a* Nocturnal ; *by which the Hour of the Night may be very accurately known by any Star in the* Meridian. *The firſt was the Contrivance of my Worthy Friend Mr.* Palmer ; *the other is the Invention of my very good Friend Mr.* Foſter, *ſometime Profeſſor of* Aſtronomy *in* Greſham-Colledge ;

both

both whoſe Memories I muſt ever honour, as Perſons to whoſe Conduct I muſt acknowledge to owe a great part of that Knowledge I have attained in theſe Sciences. Thus, Reader, *thou haſt my Deſign and End in the Publication of theſe Trifles, which is no other than to Confirm thoſe that are Learned in their further Search into them, and to facilitate others in the Practice of theſe moſt Uſeful Sciences; in the Commendation of which I will not now enlarge my ſelf, who ſhall be glad to hear theſe Papers pleaſe any: if they have other Fortune, let them paſs among thoſe Idle Pamphlets, under the Burthen of which the Preſs now dayly labours.*

The


W. Hayes fe.

THE USE OF THE General Planiſphere CALLED THE Analemma,

In the Reſolution of ſome of the Chief and moſt Uſeful PROBLEMS of ASTRONOMY.

PROBLEM I.

The Sun's Place being given, to find his Declination.

COUNT what Parallel from the Equinoctial doth cut the Place of the Sun in the Ecliptick, for that is the Declination required. So in ♉ 00° 00′ you will find the 11° 30′ Parallel cuts the Ecliptick.

PROB. II.

Contrarily, the Declination being given, to find the Sun's Place.

Count 11° 30′ among the Parallels, and that will cut 00° 00′ of ♉.

PROB. III.

The Place of the Sun being given, to find his Right Ascension.

Look what Meridian, reckoning from the Center, doth pass through the Suns place, for that in Degrees is the Right Ascension required. So will the Right Ascension for the beginning of ♉ be found 27° 54'. So likewise for the beginning of ♏ ; to which adding 180, because 'tis a Southern Sign, the Right Ascension will be found 207° 54'.

PROB. IV.

The Elevation of the Pole, and Degree of the Ecliptick being given, to find, 1st. *The Ortive Latitude.* 2dly. *The Rising and Setting of the Sun.* 3dly. *The Semidiurnal Arch.*

Place the Finitor to the Latitude, then see what degree thereof doth cross the Sun's Parallel, for the Degree in the Ecliptick given, for that is the Ortive Latitude sought, being reckoned from the Center, or East point in the Instrument. So in the Latitude of 49 I find the Ortive Latitude about 38 in the Tropick of *Cancer*. 2*dly*, The Meridian there passing, shews the Sun's Rising to be very near four in the Morning. And 3*dly*. The Semidiurnal Arch to be 8 hours, and so the longest day there 16 hours.

PROB.

PROB. V.

The ſame things being given, to find the Aſcenſional Difference.

The Horizon, as before, being ſet to the Latitude, count from the Center to the Meridian that cuts it in the Sun's Place for that day; that is to ſay, in the Sun's Parallel for the place of the Eccliptick given. So ſhall you find the Aſcenſional Difference for the beginning of ♉ in the foreſaid Latitude of 49° to be 13° 32′.

PROB. VI.

To find the Oblique Aſcenſion.

Firſt, find the Right Aſcenſion by the third Problem, and the Aſcenſional Difference by the preceding one. In Northern Signs ſubduct the Aſcenſional Difference out of the Right Aſcenſion, but in Southern Signs add it. So ſhall the Summe, or Difference give you the Oblique Aſcenſion required. So in the beginning of ♉ I find the Sun's Right Aſcenſion 27 54, and in the Latitude of 49° 00′, his Aſcentional Difference 13° 32′, their Difference is 14° 22′, which is the Oblique Aſcenſion for the beginning of ♉. So the Oblique Aſcenſion for the beginning of ♏, will be found 221° 26′ by adding 13° 32′ to 207° 54′, the Right Aſcenſion before found.

PROB. VII.

To find the Oblique Ascension of any other Point in the Ecliptick, not reckoning from the Æquinoctial points, by which you may know whether the said Sign doth ascend Right, or Obliquely.

By the preceding Problem find the Oblique Ascension for the beginning and end of ♉, or any other Arch propounded, then subducting the lesser out of the greater, the residue is the Oblique Ascension required. So in the Latitude of 49° 00′ I desire to know what degrees of the Æquinoctial do in an Oblique Sphere ascend between the beginning and end of ♉, I find the oblique Ascension for the beginning of ♉ to be 14° 22′, and of the latter end 32° 45′, their Difference is 18° 23′, the Oblique Ascention required. Where note, because the remaining Summe is in the Example less than the given Arch, the said Sign doth ascend Obliquely, contrarily if it had been greater.

PROB. VIII.

To find the Hour of the day, the Altitude of the Sun being first observed.

Set the Ruler to the Latitude, and remove the Vertical till it cross the Sun's Parallel in the Altitude observed, the Meridian there passing shews the hour of the day. So in the beginning of ♉ in the Latitude of 52° 00′ I observed the ☉ Altitude 27° 18′, and the 60*th*. Meridian doth cross the Sun's Parallel in that Altitude, therefore it was then eight

eight of the Clock in the Morning. Thus alſo may you make a Table of Altitudes for every hour of the day, by removing the Vertical from hour to hour, and obſerving the Degrees of Altitude cut off by the ſeveral Meridians.

PROB. IX.

To find what Degree of the Ecliptick is in the Meridian at any hour given.

Find the Right Aſcenſion by the third Problem, then turn the hour given from the Meridian into degrees and minutes of the Æquinoctial, add unto theſe the Right Aſcenſion found, then examine what point in the Ecliptick doth anſwer to thoſe Degrees of Right Aſcenſion, which is done by following the Meridian, which ſhews the Right Aſcenſion up to the Ecliptick, for that part of the Ecliptick is in the Meridian.

So in the beginning of ♉, and at the hour of nine in the Morning, I find the Right Aſcenſion 27° 54′, the hours from the Meridian laſt paſt 21° 00′ in degrees 315°, to which I add 27° 54′, it makes 342° 54′ which is the Right Aſcenſion for the 11*th.* Degree of ♓, or near, which was the degree of the Ecliptick then in the Meridian, which will be ♓ 11° 30′.

PROB. X.

To find the Sun's Azimuth at any Altitude given.

Place the Finitor to your Latitude, and remove the Vertical till it interſect the Sun's Parallel in the Altitude given, then applying it over in the Æquinoctial-line, the Meridian which interſects the Vertical in the given Altitude, ſhews the

the Sun's Azimuth, or Distance from the South or East, as you shall please to account it. So in the Latitude of 48° 50′, the Sun's Altitude being 31° 40′ in the Tropick of ♋. Then moving the Vertical till it cross the Parallel of ♋ in that Altitude, I there find it, and then moving the Horizon over in the terms of the Æquinoctial, I find that 88° 2′ Meridian doth cross the Vertical in the Altitude given, which is the Azimuth from the South. Here you are to take notice, that those which were before Meridians are now become Vertical Circles in this manner of working.

PROB. XI.

To make an Horizontal DIAL.

Set the Horizon or Finitor to the Latitude of that place for which you desire to make your Dial, and then observe the several Angles made by the Meridians upon the Horizon, which express upon your Plain, and let your Style make an Angle equal to the Latitude of your Place for which you make your Dial. This needs no Example.

PROB. XII.

To make an Upright Vertical DIAL.

Set the Ruler to your Latitude, and the moveable Vertical in the Center of your Instrument, then observe the several Angles made between the 12 of Clock line and the other Meridians, not upon the Horizon, as you did before; but upon the Vertical, and those shall be the hour spaces required. So in the Latitude of 49° the angle of 11 will be 9° 57′, and also for 1; 20° 44′ for 10 *h.* and 2 *h.* 33′ 16′ for 9 *h.* and 3 *h.* and so the rest.

PROB.

PROB. XIII.

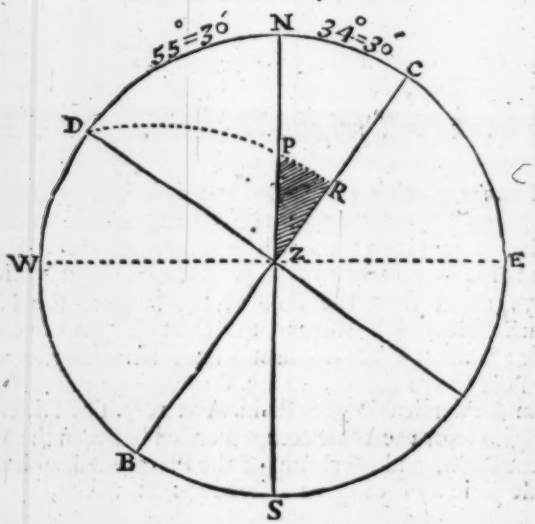
To make a Upright Declining DIAL.

For the placing the Style, and drawing the Hour-lines there must necessarily be resolved a Sperical Rect-angled Triangle, in which there will be given, beside the Right Angle, the Complement of your plains Declination (which I allways count from the Pole of the Plain to the North or South Points) and thirdly, the Complement of your Latitude; by help whereof you may find, 1st. The Elevation of the Pole above the Plain. 2dly. The distance of the Substyler from the Vertical in your Plain. And 3dly. The Difference of Longitude, or the Angle comprehended between the Meridian of the Plain, and Meridian of the Place. All which will be made plain by the Figure following: in which,

The Scheme following represents a South Plain Declining from the North Westward 55° 30′ in the North Latitude 46° 12′.

The

The Latitude is 46° 12'.



Let *E N W S* be the Horizon of the place and the letters as they are in their order, mark, the East, North, and West and South points. Let then a plain *B C* be given, the pole whereof will be D, the Meridian of the Plain which passeth allwayes through *P*, the pole of the world, and *D* the pole of the plain *D P R*, the Declination *D Z N* the Complement thereof *N Z C*, the Triangle to be resolved *P Z R*, in which are given;

1st. *P Z R* the Complement of the Declination. 34° 30'.

2dly. *P Z* the Complement of the Latitude 43° 48'.

3dly. *P R Z* the Right Angle.

Things required are,

1*st*. *P R* the Elevation of the Pole above the Plain.

2*dly*. *Z R* the distance of the Substylar from the Vertical, or the angle made between the Substylar and the Meridian, or line of 12 *h*.

3*dly*. *Z P R*, the Difference of Longitude, or the angle comprehended between the Meridian of the Plain, and of the Place.

Now

Now these things are thus found at one Operation by this Instrument.

1*st*. Reckon from the Æquinoctial towards the Pole, the Complement of the Declination of your Plain, which in our Example will be 34° 30′, at that point place the Horizontal Ruler, then from the Center of your Instrument towards the Limb, reckon upon the Horizontal Ruler, the side given *P Z* the Complement of your Latitude, and the Parallel there intersecting being reckoned from the Æquinoctial, shall be *P R* the Elevation of the Pole above your Plain.

2*dly*. The Instrument standing in the same situation, count from the Limb of your Instrument towards the Center among the Meridians, the Complement of your Latitude, for the Meridian, there intersecting the Horizon, shall, upon the Degrees of the Horizon give you *Z R*, the Distance of the Substylar from the Meridian of the Place.

3dly. the Parallel of Declination in the common Intersection of the foresaid Meridian with the Horizon, being numbred from the Pole of the World, doth give you the Angle sought, Z P R, or the difference of Longitude. But because it may some times fall out, that the said Intersection will be more then 23° 30′, and in little Instruments the Parallels not drawn beyond the Tropicks, which are 23° ½ from the Æquinoctial: in that case you may thus help your self: at the common Intersection make a little spot of ink or red Ocre with your pen, and then putting the Horizon back to the terms of the Æquinoctial, run the movable Vertical to the said mark, the degrees of which shall shew you the Angle sought, counted from the Pole of the world; or otherwise place one foot of your compasses in the said Intersection, and take the neareſt Distance between that and the Æquinoctial, which being applyed over, either in the limb, or Vertical, shall give from the Æquinoctial the Angle required.

EXAMPLE.

In the Latitude of 46° 12′ a South Plain declines from the North Westward 55° 30′; I place the Finitor to 34 degrees, 30 minutes upon the Limb, which is the

Complement of my Declination, and is represented by the Arch *N C* in the Scheme equal to *W D*, and from the Center reckon the Complement of the Latitude for which the Declining Dial is made, *Viz.* 43° 48′, and there I find the Parallel 23° 05′ to meet or intersect 43° 28′ which is *P R*, the Elevation of the Pole above the Plain.

2dly. In the same situation of the Instrument, reckoning the Complement of my Latitude among the Meridians, from 12 of the Clock, or first Meridian, I find the 43° 48′ Meridian doth cut the Horizon in 38° 19′, which is the Distance of the Substylar from the Meridian of the Place, *Viz. Z R.*

3dly, and lastly, I find from the Pole, the 63° 37′ Parallel doth pass through that Meridian in its common Intersection with the Horizon, or *Z P R* the Difference of Longitude.

These things being thus found, *Viz.*

The Elevation of the Pole above the Plain, —— 23° 05′
The Angle of the Substylar, —— —— —— 38 19.
The Difference of Longitude, —— —— —— 63 37.

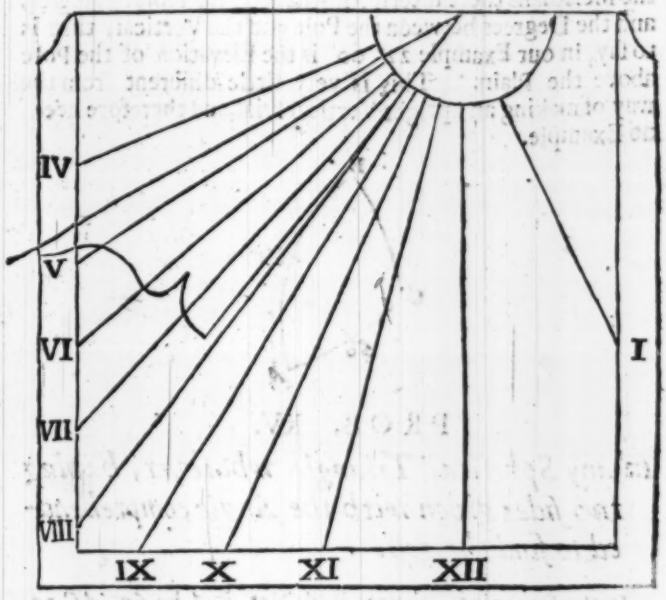
The hour spaces are thus found. By the Difference of Longitude you may know that the Substylar falls four hours 3° 37′ from the Meridian, place therefore to 3° 37′ from the Meridian the Horizontal Ruler upon the Limb, and then reckon from the Center among the Meridians the Elevation of the Pole above your Plain, and look what Parallel doth intersect that Meridian, and the Horizon; for that counted from the Equinoctial, is the Angle between the Substylar and the first hour toward the Meridian, which in our Example will be found to be 1° 25′ then remove the Horizon 15° higher, that is to 18° 37′ upon the Limb, and you shall find 7° 31′ among the Parallels intersect the Horizon in the 23° 5′ Meridian, and so forth for all the hours on that side of the Substylar. In like manner for the hours on the other side; set the Fini or to 11° 23′ in the Limb, and you shall find the Angle up n the Plain to be 4° 30′, then removing it 15° higher, you shall fin 10° 58′, and consequently the rest as they follow;

Lastly,

Laſtly, Becauſe the Plain is a South Plain Declining from South Eaſtward, that is, from the North Weſtward, the Style muſt be placed among the Morning hours on the Weſtern ſide, and the Dial will be as followeth.

Morning Hours.

8 *h.*	1°	25′.	7	4°	30′
9	7	15	6	10	38
10	14	35	5	19	01
11	23	57	4	30	28
12	18	19			
1	62	48			



PROB. XIV.

To draw the Hour-lines upon a Reclining Plain, whose Face looketh directly toward the North or South.

Let a Plain be given, reclining from the Zenith toward the North 20° in the Latitude of 49° 00′. Here I set the Finitor to the Latitude, and the moveable Vertical to the Degree of Reclination, reckoning from the Zenith towards that Pole towards which the Reclination is. As in our Example of 20° Reclination towards the North Pole, the Meridians there intersecting denote the Horary Angles, and the Degrees between the Pole and the Vertical, that is to say, in our Example 22° 00′ is the Elevation of the Pole above the Plain. This is very little different from the way of making an upright Vertical Dial, and therefore needs no Example.



PROB. XV.

In any Spherical Triangle whatever, having two sides given with the Angle comprehended to find the rest.

In the foregoing Triangle *B A C* let *B A* be 60, *A C* 50, and the angle *B A C* 30.

Reckon

Reckon on the Limb from the Æquator toward the North Pole, and on that ſide of your Inſtrument that is on your Right Hand, one of the ſides given, *Viz.* *AC* 50°, and there place the Horizontal Ruler, and then among the Parallels from the North count the other ſide *AB* 60°, and among the Meridians from the Left Hand, there count the Angle given, *Viz.* 30° *BAC*, & at the common Interſection of that Meridian with the Parallel, place the Moveable Vertical; this being done, apply the Horizontal Ruler over in the terms of the Æquinoctial, ſo ſhall the Degree in the Vertical, which was before obſerved, *viz.* 26½, in the common Interſection of the Meridian with the Parallel, give you among the Parallels, reckoning from the Pole the Baſe 26° ½, and among the Meridians, from the utmoſt on the Right Hand towards the Left you ſhall find the Angle *C.* 103. Now for the Angle *B*, count *AB* 60° in the Limb, and there place the Horizon, and count the ſide *AC* 50° among the Parallels, and among the Meridians towards the Righ Hand, count the Angle given 30°, and apply the Vertical to the common Interſection, then apply the Horizon as before over in the Æquinoctial; ſo among the Meridians fron the utmoſt on the Right Hand towards the Left, you ſhal in the common Interſection find the Angle unknown *B* 59½ So have you now in your Triangle the three ſides and tw Angles, the third Angle may be found either by letting fal a Perpendicular, or continuation of the ſides to a Semicircle

PROB. XVI.

To find when the Twilight begins and ends.

The Twilight in the Morning begins when the Sun is diſtant 18 degrees from the Horizon, & continues till it Riſe; and at Night begins at Sun Set, and continues till he is 18 degrees below the Horizon, and then Darkneſs begins.

To find this, you muſt know the Place of the Sun, and his

his Declination. The Sun's Place may be known by most Almanacks, or by a Scale, which may be annexed to any convenient Place in the Instrument. The 2*d.* to wit, the ☉'s Declination, is found by the first Problem.

Example First. If the ☉ be in the Æquinoctial, he hath no Declination; if you therefore place the Finitor to the Latitude of your Place, move your Vertical till the 18*th.* degree thereof crosses the Æquinoctial, and mark what Meridian that is, counting from the Center of your Planisphere, which in the Latitude of 52 degrees, you will find to be the 30*th.* Meridian; so that you may conclude the Twilight begins two hours before ☉ Rise, and at Night ends two hours after ☉ Set.

But if the ☉ have Declination, you must observe that Meridian which crosseth the 18*th.* degree of the Vertical in the Parallel of Declination.

Example. Suppose the ☉ to be in ♊ 00° 00′ in the Latitude of 52° 00. When the ☉ hath 20° of Declination, and observe the Intersection made by the 18*th.* degree of the Vertical, and the 20*th.* Parallel of Declination, and there you may observe the 33 Meridian, or thereabout, from ☉ Rising, passing which sheweth the Twilight will then end, to wit, 2 hours and 12′ before the ☉ should rise, but at this time you will find the ☉ is up, which teaches you there is then no Twilight at all. So in the Winter, the ☉ Sets so much before 8 *h.*, that it will not come to be 18 degrees below the Horizon till ☉ Rise, and will continue so till the ☉ comes back to ♌, there will be no dark time in that Latitude, if the Sky be not Cloudy.

PROB. XVII.

Of Spherical Rect-angled Triangles in all their Varieties.

I have in the third and fourth Problems foregoing, shewed you the Solution of some Questions, wherein the Triangle hath

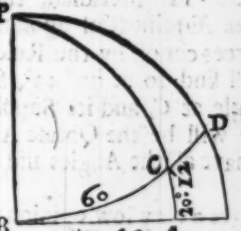
hath been Rect-angled and Spherical. I ſhall now handle the Uſe of them more fully, and ſhew you how three parts, that is, two beſide the Rectangle, which is always known, being given; the other parts ſought, either Sides or Angles may be by this Planiſphere many ways concluded, as will appear in Practice.

1. In the Scheme.

B C 60° 00′ }
B A 57 48 } Data.
Rad. —— }

2 Or,

B C 60° 00′ }
C A 20 12 } Data.
Rad. —— }



The Data in the Triangle in our following Geniture are 3° 00′ ☉ Long. 1½ ☉ Declin. with the Rect. and the Angle at *C* will be found 66° 32′, which will be demonſtrated by the Scheme, *N*° 4.

The Proportions in *Trigonometry* are thus: *B C* Rad. *B A. C* Scheme 1. Or, *C A.* Scheme 2. *P C* Rad. *P D. C.* That is, As the Coſine of the Declination given is to the Radius, ſo is the Coſine of the greateſt Declination to the Angle ſought.

In the Triangle *B A C* Rect-angled, at *A* the Longitude, *B C* is 60° 00′; the Right Aſcenſion may be found by Problem 3*d*. 57. 48, and the Angle at *B* 23° 30′. Now to find the Declination, do thus: Chooſe out the 57° 48′ Meridian, and then move the Horizontal Ruler till the 60*th*. degree from the Center meets the 57° 48′ Meridian, which you will find will be 20° 12′ the Declination ſought, if you count the Parallels from the Æquinoctial till the Interſection is made in the 57° and 48′ Meridian: or if you have the Declination given, bring down the Horizontal Ruler to the Æquinoctial, and you will find the 57° 48′ of the Ruler will be cut by the 57° 48′ Meridian. But

But we still want the Angle *C*; to obtain this, we must turn the Triangle, and as in the annexed Scheme, call *B A* 20° 12′ and *A C* 57° 48′: choose now the 20° 12′ Meridian, and remove the Horizontal Ruler till the Longitude given, *Viz.* 60° doth intersect the 20° 12′ Meridian, then count from the Æquinoctial upon the Limb the Degrees cut off by the Ruler, which you will find to be 77° 43′, for the Acute Angle at *C*, and its Supplement 113° 17 will be the Obtuse Angle. So you have all the Angles and Sides of your Triangle.



Though I have a very low opinion of Astrology, especially as our *Genethliacall-men*, or rather *Fortune-Tellers* use it; yet that I may shew the excellent use of this Planisphere, and because it may be useful to know the figure of the Heavens in Eclipses, and the Ingress of the Sun into the Æquinoctial points: I shall now shew you how to place the 12 Houses with the Signs to them belonging. In this I shall take for *Example* a geniture long since past, and not agreeable to any *Example* before given, that by variety of Operations the Reader may better comprehend the use of the Instrument.

PROB. XVIII.

How to erect a Figure of the Heavens.

First for the time propounded you must first find the Suns place, that is, in what Degree of the Ecliptick the Sun is in at the time proposed; and afterward, in the following *Example*; I shall teach you to find the *Medium Cœli*, or that degree of the Ecliptick that is in the Meridian.

EXAMPLE.

Suppose a Geniture to be upon the ninth day of *December*, at six of the Clock in the Evening, in the Year 1571.

The

The place of the Sun was then found 27° 17′ of ♐, and his Right Aſcenſion will be found 267° Add to this 90° which is ſix hours after Noon in the degrees of the Æquinoctial, which will give you the Right Aſcenſion of the Mid-Heaven, *Viz.* 357° to which will anſwer 27° or rather 26° 46′ ♓ ; for the *Medium-Cœli*, and his oppoſite 27° or 26° 46′ of ♍ for the *Imum-Cœli*, ſo you have the 10th and 4th Houſe found,

Your next work will be to find the degree of the Ecliptick, which will be in the Aſcendant for the Latitude [Lat. 53° 00′] of the place of Birth. Now by adding 90° to the Right Aſcenſion of the Mid-Heaven, you will have the Oblique Aſcenſion of the Aſcendant : In our Example the Right Aſcenſion of the Mid-Heaven is 357°, to which, by adding 90 the Summe will be 447 ; out of which take 360, the reſidue will be 87°, which is the Oblique Aſcenſion of the Aſcendant. Now to know to what Degree of the Eccliptick this belongs, muſt be known by a Table of Oblique Aſcenſions fitted to your Latitude, which you may make by the fifth and ſixth Problem, but it is better to take it out of the Table at the end of this *Treatiſe*, where the Oblique Aſcenſion may be found for every Degree of the Eccliptick for ſeveral Latitudes ; by which you may ſee, that in 53° of Latitude, the Oblique Aſcenſion 87° will be between the 25 or 26°of ♋, the Aſcendant will be in ♋ between 25 and 26°.

The Aſcending Signs,	♍	♎	♓	♈	♉	♊
Deſcendant. ——	♋	♌	♍	♎	♏	♐

By this you may know the four Cardinal Points or Angles, to wit, the 10*th*. the 1ſt. the 4*th*. and the Seventh. By which all Queſtions of Life, Parents, Marriage, and Preferment, or Honour are (according to their Rules) foretold

PROB. XIX.

In order to find the Cusps of the other Houses, divers Spherical Triangles are to be Resolved.

We had before shewed how to find the Angle between the Meridian and the Eccliptick, to be 66° ½, by Prob. 7. which we shall now find another way.

The Degree culminating, or the Medium-cœli was ♓ 26½, and consequently its Distance from ♈ was 3° ½: count therefore 3° ½ among the Meridians, from the utmost towards the Center, then remove the Horizontal Ruler downward towards the Antartick Pole, the Fiducial Edge of the Vertical remaining fixt at the Center, till such time as the Vertical shall cross the 3 ½ Meridian in the Artick Circle, that is, in the 23½ Parallel from the Pole, and in the Limb you shall meet the 66° ½, which is the Angle between the Meridian and the Eccliptick.

2*dly*. Things standing all in this Posture, look from the extremity of the Vertical Ruler to the 3 ½ Meridian, there you will find 1½ crossing, which is the Declination of the Mid-Heaven Southward; take this out of 37° the Complement of your Latitude, there rests 35° 30′, which is the Altitude of the Mid-Heaven, or the Degree culminant, because the Declination is Southward, otherwise it must have been added.

3*dly*. Number 35° 30′ from the extremity of the Vertical, and this will, among the Parallels from the Pole, shew about 42° ½, or thereabout, which is the Angle made between the Eccliptick and the Horizon.

4*thly*. Count among the Meridians from the utmost to that point, and you shall find the 61st. Meridian there, which is the degree of the Eccliptick between the Meridian and the Horizon.

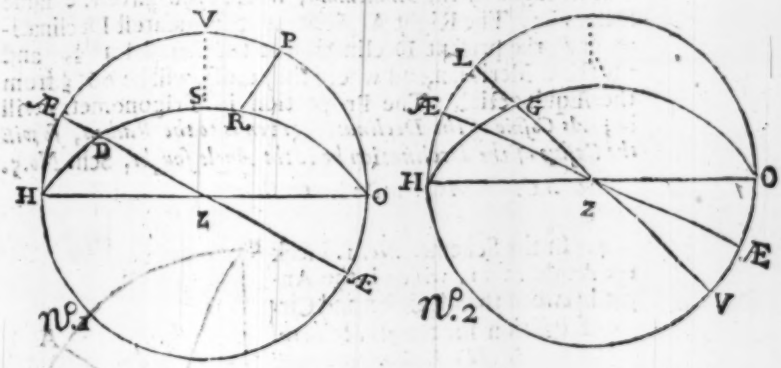
Lastly,

Lastly, You shall find the same Degrees of the Ecclipticke, (*Viz.* 61) if you count the 35 ½, or thereabout, from the Center for those Degrees of the Ruler will shew you 61, as before.

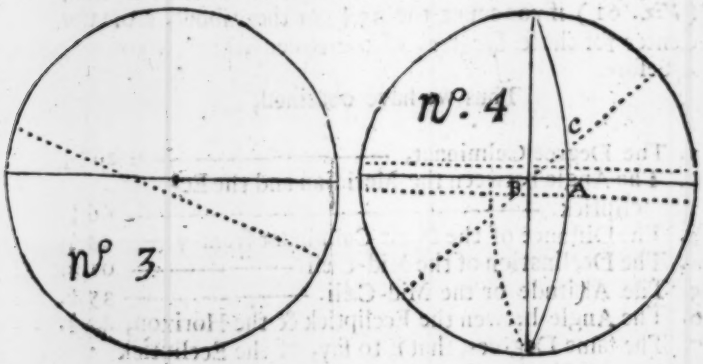
Thus we have obtained,

1. The Degree Culminant, —— ♓ 26° ½
2. The Angle between the Meridian and the Ecliptick. —— 66 ½.
3. The Distance of the Point Culminant from ♈ —— 03 ½.
4. The Declination of the Mid-Cæli. —— 01 ½.
5. The Altitude or the Mid-Cæli. —— 35 ½.
6. The Angle betwen the Eccliptick & the Horizon, 42 ½.
7. The same Degrees, that is to say, of the Eccliptick and Horizon two ways, —— 61 ½.

All these things will be made plain by the following SCHEMES.



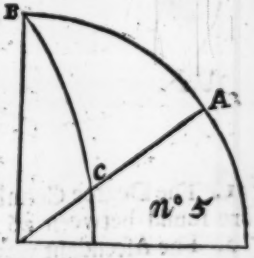
1. The Degree Culminant, that is, the Mid-Cæli was before found between 26 and 27° of ♓, neer the 27°.
2. The Ascendant was found between 25 and 26° of ♎.



3. The Angle between the Meridian and Eccliptick represented in the Scheme, *No.* 2, by the angle at *L*, may be found by the Precept of the 15*th.* Problem, and will be 66 ½, and the Triangle *B A C* in the Scheme, *No.* 4, is equipollent to that wrought by the *Analemma*, where you have the same Data, *Viz.* The Right Angle at *A*, the greatest Declination at *B*, the present Declination at the Parallel 1° ½, and the third Meridian, and where they cross, will be 66° ½ from the Æquinoctial. The Proportion in Trigonometry will be, *As Cosine of the Declination given is to the Radius, so will the Cosine of the Declination be to the Angle sought.* Sch. *No.* 5.

As *B C.* *B A C* :: Rad. to *C.*

4. In the Scheme, *No.* 1. I seek the Angle at 11, which is the Angle between the Meridian and Circle of Position for the 9*th.* & 11*th.* Houses. *As H Æ Sin. to D Æ Tang.* :: *Rad. to the Tang. of the Angle at H. which will be found* 44. 47.



In the Scheme, *No.* 1. in the Rect-angled Triangle *P R O* Rect-angled at *R.* *P R*, the Elevation of the Pole above that Circle of Position, is found by this Proportion.

As

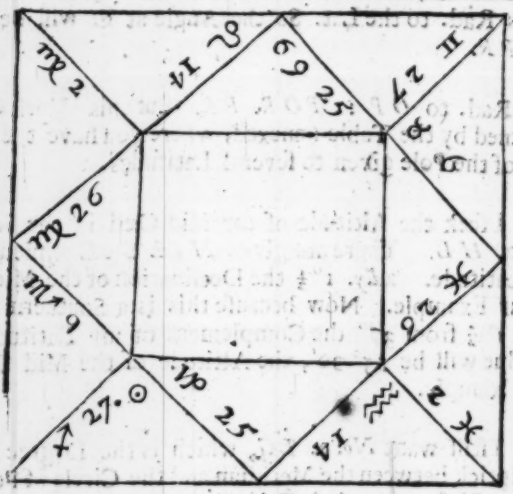
As Rad. to the Lat. So the Angle at ☉ will be to the ſide $P_{\odot}R$.

Rad. to $OP :: POR. PR$. But this Work will be ſhortned by the Table annexed, where you have the Elevation of the Pole given to ſeveral Latitudes.

6. I ſeek the Altitude of the Mid-Cæli in the Scheme, *No.* 2. HL. There are given $H\text{Æ}$ the Complement of the Latitude. 2*dly*. $1^{\circ}\frac{1}{2}$ the Declination of the Mid-Cœli in our Example. Now becauſe this is a Southern Sign, I take $1^{\circ}\frac{1}{2}$ from 37° the Complement of my Latitude, the Reſidue will be $35^{\circ}\ 30'$, the Altitude of the Mid-Cœli in our Example.

7. I ſtill want *No.* 2. LG, which is the Degree of the Eccliptick between the Meridian and the Circle of Poſition. In the Oblique-Angled Triangle HLG you have given HL, the height of the Mid-Cæli, with the two Angles at O and L, by which LG may be found by *Trigonometry*, according to the Rules delivered by Artiſts, by letting fall a Perpendicular either within or without the Triangle, when two Angles and the adjacent ſide is given. In this manner you may ſet a Figure of the 12 Houſes, which will be near as the Figure adjoyning.

A Scheme.



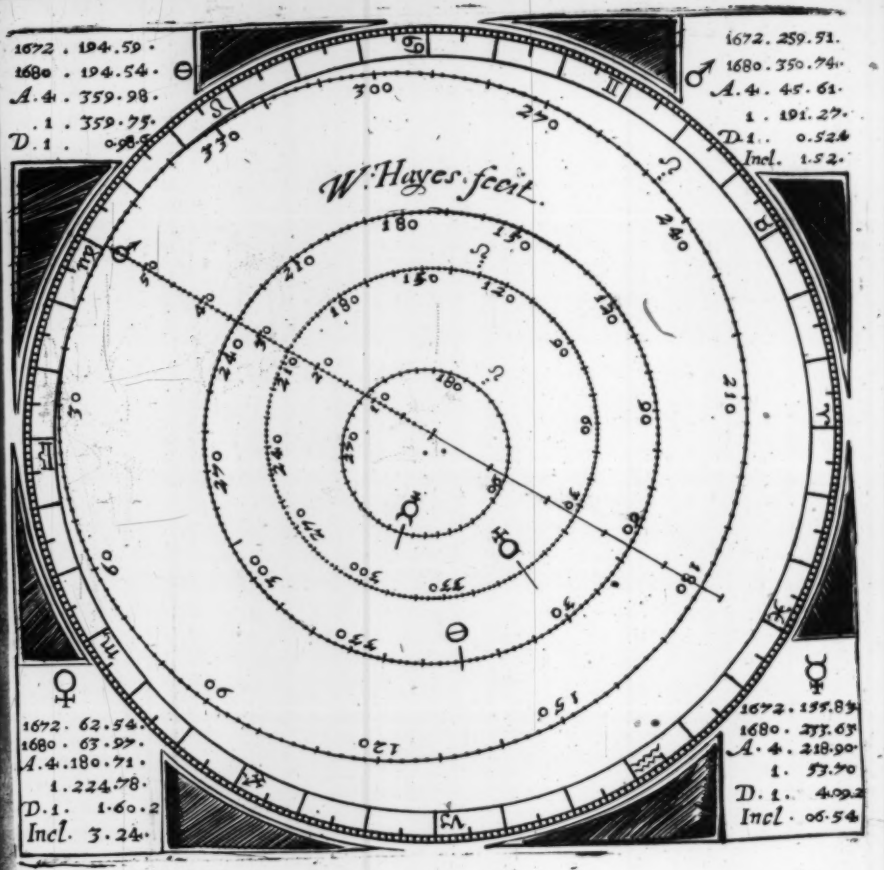
A Table of the Houses

Lati. Locorum.	Undecim. & 3æ, nec non 9æ 74	Duodecimæ & secundæ, nec non 8æ & 6æ Domorum.
46	27.22	41.53
47	28.11	52.53
48	29.02	43.53
49	29.54	44.55
50	30.47	45.55
51	31.41	46.56
52	32.37	47.57
53	33.34	48.59
54	34.32	50.01
55	35.42	51.03

FINIS.

Advertiſement.

FOraſmuch as the *Practice* of *Aſtronomy* depends much upon the exact making of the Inſtruments; Theſe are to give notice, that theſe, and all other Inſtruments for the *Mathematical Practice*, are accurately Made and Sold by Mr. *Walter Hayes*, at the *Croſs-Daggers* in *Moor-Fields*, next Door to the *Popes-Head-Tavern*, *London*; where they may be furniſhed with Books to ſhew the Uſe of them: As alſo with all ſorts of *Maps*, *Globes*, *Sea-Plats*, *Carpenters-Rules*, *Poſt*, and *Pocket-Dials* for any Latitude, at Reaſonable Rates.


W: Hayes. fecit.
1672 . 194.59 .
1680 . 194.54 .
A.4 . 359.98 .
. 1 . 359.75 .
D.1 . 0.98 .
1672 . 259.51 .
1680 . 350.74 .
A.4 . 45.61 .
1 . 191.27 .
D.1 . 0.524
Incl. 1.52 .
1672 . 62.54 .
1680 . 63.97 .
A.4 . 180.71 .
1 . 224.78 .
D.1 . 1.60.2
Incl. 3.24 .
1672 . 155.83
1680 . 233.63
A . 4 . 218.90
1 . 57.90
D . 1 . 4.09.2
Incl . 06.54

THE

Planetary Inſtrument.

OR THE

Deſcription and Uſe of the *Theories* of the *Planets* : drawn in true *Proportion*, either in one, or two Plates, of eight Inches Diameter ; by *Walter Hayes*, at the *Croſs-Daggers* in *Moor-Fields*.

Being excellent Schemes to help the Conceptions of Young *Aſtronomers* ; and ready Inſtruments for finding the *Diſtances*, *Longitudes*, *Latitudes*, *Aſpects*, *Directions*, *Stations*, and *Retrogradations* of the *Planets* ; either *Mechanically*, or *Arithmetically* ; with Eaſe and Speed.

By Mr. *John Palmer*, Rector of *Ecton*, and Arch-Deacon of *Northampton*.

UNIVERSITY LIBRARY CAMBRIDGE

The DESCRIPTION.

THE firſt Plate (which I call *Saturn's* Plate) contains the *Theories* of ♄ ♃ ♂ ☉ : alſo ſhort, but ſufficient Tables of their *Anomalies* ; and a Scale for meaſuring their Diſtances in *Semidiameters* of the Earth.

The ſecond Plate (which I call *Mars's* Plate) contains the *Theories* of ♂ ☉ ♀ ☿, with like Tables of their *Anomalies*, and *Scale* of *Diſtances*.

The *Sun* is in the Center of the *Plate*. The other Planets have their several *Eccentrics* & *Orbits*. These should be *Ellipses*, but *Circles* will serve sufficiently, especially for *Instruments*. Mr. *S. Foster* disposed these *Planets* in four Plates, and added thereto other Devices, to be seen in a Book published since his Death. Here they are all contrived in two Plates, or two sides of one Plate: and whereas Mr. *F.* supposed the *Apheliums* and *Nodes* moveable, in these *Thories* they are fixed, according to Mr. *Street's Hypothesis*: by which means, though they be framed to the end of 1680, yet not only for this Age, but (with allowance of the Procession of the *Æquinoctial*) they may serve perpetually.

The *Aphelium* of a *Planet* is the point of his *Eccentric*, which is furthest from the *Sun*, and from *Aphelium* is the *Anomaly* counted.

The *Anomaly* is the circular Distance of a *Planet* from his *Aphelium*. But though the *Anomalies be equal*, yet their Divisions in every *Eccentric* are unequal, because they are made to contain the *Aggregates* of the *Anomalies*, and *Prosthaphoreses* of the *Orb* compounded together.

Where you see two or three pricks on one side the *Orbit*, and ☌ on the other side, there the *Planet* goes into *North Latitude*, and at the opposite Point over the *Center*, is the Place of ☍, where he goes into *South Latitude*.

The Use of the *THEORIES*.

This shall be shewn in three *Examples* only, which may suffice.

But, *Note* 1. That I begin the Years and Days 24 hours later than Mr. *Street*; for I count the last day of *December* to end in the *Noon* of the *Circumcision*; which is the old way: and to that Account these *Theories* and *Tables* are fitted: and all Years and Days here are counted Compleat.

Note 2. That in gathering the *Anomalies* out of the *Tables*

Tables, if the same exceed a *Circle*, (or 360°) you must by *Subtraction*, or *Division*, cast away all whole *Circles*, take the *Remainder* for the *Anomaly* sought. The Numbers in the *Tables* are *Degrees*, and *Centesimal* parts, and for the *Diurnal Motion*, another *Figure* is added, to make the Parts *Millesimal*. In the *Tables*, A. stands for *Anni*, that is, *Years*: D. stands for *Days*: *Incl.* stands for *Inclination*; which is set down in *Degrees* and *Minutes*.

EXAMPLE. I.

1675. *April* 1. I saw *Mars* above the foremost foot of *Apollo*, and he seemed to be much diminished in Magnitude.

First out of the Table for ☉.		For ♂.
write out for 1672	194. 59.	259. 51.
for two Years more	359. 75.	191. 27.
	359. 75.	191. 27.
for 90 days the product of 986 by 90 is	88. 74.	524 in 90 — 47. 16.
	1002. 83.	689. 21.
for 2 *Circles* deduct	720.	deduct 360.
Anomaly of ☉	282. 83.	*Anomaly* of ♂ 329. 21.

Now in the *Earths Orbit*, at 283, make a prick with Ink for ☉; for there is ☉ for this time: and likewise prick ♂ in his *Orbit* at 329.

Lay a Ruler from the Place of ☉ over the ⊙ (in the *Center*) and it shall cut in the *Limb* ♈ 21° 38′, the ⊙'s *Longitude*. Again, lay a Ruler from ☉ to ♂ (I mean, the pricks set for them) and know, that a Line Parallel to your *Ruler*, passing through the ⊙ (or *Center*) will cut in the *Limb* the *Longitude* of ♂.

Take therefore with your *Compasses* the neerest distance of the *Center* from the *Ruler*, and let one foot slide along the *Ruler* from ☉ to ♂, and beyond him; and let the other

foot, keeping even pace with his fellows, paſs from the *Center* to the *Limb*, and ſo it ſhall touch in the *Limb* ♊ 29½, the *Longitude* of ♂.

Another way. Mark well the *Triangle* made by your two Pricks and the *Center*, that is, by ☋ ♂ & ☉. Meaſure the ſides upon your *Scale*, and you ſhall find— ☉ ☋ —3500 } *Semid.* ☉ ♂ —5700 } of ☋ ☋ ♂ —6000 }

Now if you have 2 *Thrids* from the *Center*, and lay one upon ☋, and the other upon ♂, the *Arch* of the *Limb* between them, is the Meaſure of the *Angle* at the ☉, (or of Commutation) and is here 77° 42′. With this *Angle* and the Sides comprehending it (which are 35 and 57, as before) you may by *Pitiſcus* his third *Axiome*, Calculate the other *Angles*, and find *Ang.* at ☋ (or *Elongation*) 67°. 41′, and *Ang.* at ♂ (or *Paralloxis Orbis*) 34° 37′. The *Elongation* of ♂ (67° 41′) added to the *Long.* of ☉ (♈ 21° 38′) makes the *Long.* of ♂, 89. 17. that is ♊ 29. 17.

Another way. Transfer your *Triangle* upon Paper, and there, by help of a *Scale* of *Chords*, or a ſmall *Quadrant*, and *Compaſſes*, you may eaſily find all the *Angles* very near the truth; *Viz. Ang.* ad ☉ 77° 42′. *Ang.* ad ☋ 67° 54′. *Ang.* ad ♂ 34° 24′.

Note, That the reaſon of ♂ his Diminution is the Increaſe of his Diſtance from the *Earth*; for you may meaſure it upon the Plate 6000: but in his ☌ he may be diſtant but 1320, and never above 2350.

For the *Latitude* of ♂, lay one *Thrid* from the *Center* to ☌, and another *Thrid* to ♂, the *Arch* of the *Limb* intercepted by the *Thrids* (76. 10.) is *Argumentum Latitudinis.*

Now as the *Radius* to the *Tang.* of 1.52′, the *Inclination* of ♂: So is the *Sine* of 76.10′ to the *Tang.* of 1.49′; the *North Latitude* of ♂ ſeen at the *Sun.*

And as ☋ ♂ to ☉ ♂; ſo is the *Tang.* of the *Lat.* at the *Sun*, to 1. 44′; the *Tang.* of *Lat.* ſeen at the *Earth.*

EXAMPLE II.

1677. *Octob.* 28. (being St. *Simon* and *Jude's*) at *Noon*, ſeek ☿ Place. 1672

	☊	☿
1672. ———	194.59	155.83
A. 4. (or 4 Years)	359.98	218.90
Days 300 ———	295.80	147.60
	850.37	522.33
Substract the *Circles*—	720.	360.
Anom. of	130.37	162.33. *Anom.* of ☿

Prick the ☊ and ☿ in their *Orbits*, at the end of these *Anomalies*, and you shall see the Prick for ☿ fall in the very *Node* at ☊; and laying a *Thrid*, or *Ruler* from the *Center* to ☿ or ☊, it shall cut them both, and shew that ☿ is in a Corporal Conjunction with ☉. This ☌ ☉ ☿ would be observed: for by the help of fit *Glasses*, ☿ may be seen in the ☉ for several hours; and according to the best *Tables*, he shall pass within 4 or 5 minutes of the ☉'s *Center* in *North Lat.*

EXAMPLE III.

1673. *May* 25. In the day time I saw ☿ with a *Telescope*, horned like the ☽ at 3 or 4 days old; and though she was so much *waned*, she appeared bigger and brighter than at any time since she came last out of the *Sun-beams*.

	☊	☿
1672.	194.59	62.54
144 days.	141.98	230.69
Anom. ☊	336.57	293.23 *Anom.* ☿.

Prick these *Planets* in their *Anomalies*, as before was taught. Lay a *Ruler* from ☊ over the *Center*, and it shall cut in the *Limb* the *Long.* of the ☉, ♊ 14.11′. The *Ruler* thus lying, draw a *Thrid* from the *Center* over ☿. Now between the *Ruler* and the *Thrid* is the *Angle* of *Commutation* (163°) and there adjoyneth to it the *Supplement* thereof (17°) which in your *Triangle* is *Angulus ad* ☉, and is measured by the *Limb*.

Lay your *Ruler* from ☊ to ☿, and the *Parallel Line* made, or

or imagined to be made, with your *Compasses* through the *Center*, will cut ♎ 17° ; the *Long.* of ♀ , and the *Arch* between this and the ☉'s Place before found, is the *Elongation* of ♀ from ☉ *Eastwards*, 32.49′. And the Summe of the *Commutation* and *Elongation* taken out of 180, leaves the *Angle* at ♀ 130.11′.

Another way. In the *Triangle* ☿ ♀ ☉, you may take all the sides in your *Compasses*, and measure them upon the *Scale*, that is, ☉☿ 3520. ☉♀ 2450. and ☿♀ 1370. Then either by *Protraction* find the *Angles* : or, the *Angle* of *Commutation* being known (17°) and the sides including by *Ax.* 3. *Pitisci*, you may compute the *Angle* at the ☿ 32.49′ and the *Angle* at ♀ 130.11′.

This *Angle* at ♀ measureth her *Waxing* and *Waning*.

Let the *Radius* be 100, the *Diameter* of ♀ 200, the *Angle* being 130.11′, the versed *Sine* thereof (165) measureth the dark part of the *Diameter* ; the residue (35) is light: So ♀ is *Waned* $\frac{1225}{2025}$ of her *Diameter* ; that is almost 10 *Digits* ; and yet she seems much bigger than when she was *Full* : because 2 *Digits* of light in her present Distance (of 1370) contain more *Seconds* of light than her full *Disk* could contain ; when coming from the ☉, she was distant about 6000, as you may measure upon the *Plate*.

How these *Plates* may be also useful for Observing *Altitudes*, *Azimuths*, *Declinations*, and *Inclinations* of *Plains*, &c. They who have any Skill in the *Mathematicks*, may easily discern without further Admonition.

FINIS.

6

The Description and Use of the NOCTURNAL; By Mr. Samuel Foster, late Reader of Astronomy in Gresham-Colledge.

With the Addition of a Ruler, *shewing the Measures of Inches and other Parts of most Countries, compared with our* English *ones; Being useful for all Merchants & Tradesmen.*

THIS *Nocturnal* is made of two *Plates*; the thick *Plate* (which I call the *Mater*) and a *Moveable Plate*, representing the *Æquinoctial*. On the *Mater*, the *Circle* doth represent the *Ecclipticke*. All the rest of the Writing, is the Names of as many of the *Fixed Stars* as the bigness of the Instrument will give leave. To these must be added an *Index* or *Label*, fastned at the *Center*, to cut the several *Circles* upon the Instrument.

The Use of the Nocturnal.

1. SET the *Label* to the *Sun's* Place in the *Zodiack*, and the *Hour* of *Twelve* in the *Æquinoctial* to the Star, whose time of coming to the *Meridian* you enquire after; and then look what hour and minute is cut by the *Label* in the *Æquinoctial*, for that is the hour of the Day or Night that the same Star will come to the *South* Part of the *Meridian*.

But you must observe, that the hours are marked in the *Æquinoctial* in this manner, { 12, 1, 2, 3, 4, 5, / 6, 7, 8, 9, 10, 11. }

Now the Difficulty lyeth, in finding whether the minutes you shall find cut by the *Label* in the *Æquinoctial*, doth belong

96...1423

long to the upper row of hours, *Viz.* 12, 1, 2, 3, 4 5, or to the under row, *Viz.* 6, 7, 8, 9, 10, 11; and whether from *Noon*, or from *Midnight*: In order to this you must know in what Sign the Star is that you observe, and take notice how far it is distant from the Place where the ☉ is that day; if it be not above three whole *Signs*, the Minute cut by the *Label*, belongeth to the upper row of hours to be accounted from *Noon*; and if the Distance of the Star, and of the ☉ be four, five, or six *Signs*, then the said Minute cut by the *Label* belongeth to the under row of hours, accounted also from *Noon*: but if the Distance of the ☉ and Star be 7, 8, or 9 *Signs*, then the *Minute* belongeth to the upper row of hours accounted from *Midnight*. Lastly, if the Distance of the ☉ and Star be 10, 11, or 12 *Signs* then the *Minute* belongeth to the under row of hours, accounted from *Midnight*. All which beforesaid shall be made clear by *Examples*.

Example the first. The ☉ being in the beginning of ♌, when will *Spica* ♍ come to the *Meridian*? Set the *Label* to the beginning of ♌, and the hour 12 in the *Æquinoctial* to *Spica* ♍ then will the *Label* cut the 59*th*. *Minute* after 4, or after 10; now this Star being in ♎, which is not above three *Signs* from ♌, it must be after 4 of the Clock from *Noon*. I conclude then that the ☉ being in the beginning of ♌, the *Spica* ♍ will come to the *South* at 4ʰ 59′ past Noon.

Example II. When will the same Star come to the *Meridian*, the ☉ being in the 10*th*. degree of ♊? The *Label* being set to the 10 of ♊, and 12 to the Star, as before, the *Label* shall cut the 35 *Minute* after 2 or 8; now it must be after 8, because the ☉ is above three *Signs* distant from the Star, and yet not seven *Signs*; so *Spica* ♍ will come to the *Meridian* at 8ʰ 35′ past *Noon*.

Example III. When will the same *Spica* ♍ come to the *Meridian*, the ☉ being in ♓ the 5*th*. *Degree*?

The

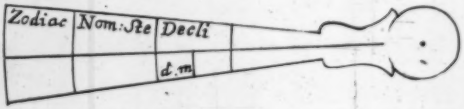
The *Label* being ſet to the 5° of ♓, ſhall cut 41′ after 2, or 8; but it muſt be 2, and after *Midnight* paſt, becauſe the diſtance of the ☉ and the Star is above ſix whole *Signs*, and not nine.

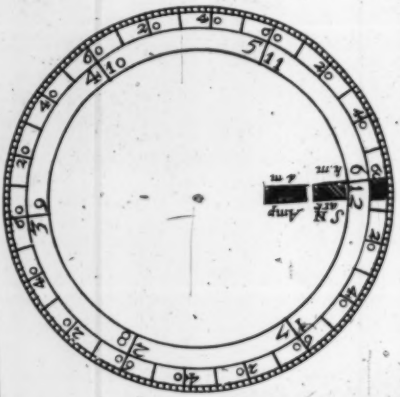
Example IV. Working after the ſame manner, you will find that the ſame Star will come to the *Meridian* at 9 *h.* 58′ paſt *Midnight*, the ☉ being in the 20° 00′ of ♍. I take the lower row of hours, and ſay, that 'tis after *Midnight*, becauſe the ☉ is above nine *Signs* diſtant from the Star. *NB.* Theſe Precepts are fitted to an *Inſtrument* made for 1671.

Additions to the Inſtrument, in Braſs; *made by Mr.* R. Aug. *1ſt.* 1684.

Calculated for the Year 1700, which will make ſome little difference in the aforeſaid Precepts.

IF in this Inſtrument you ſet down to the ſeveral Stars their reſpective ſeveral *Declinations*, and by adding either an *A*, or *B*, according to the *Declination* of either *Auſtral* or *Boreal*, you ſhall have the height of the Star when it cometh to the *Meridian*, *Viz.* by adding the *Declination* to the height of the *Æquinoctial*, when the ſaid *Declination* is *Northward*, and by taking the *Declination* from the height of the *Æquinoctial* when the *Declination* is *Southward*.


Zodiac
Nom: Ste
Decli
d. m


Sag
Arc
Amp
d. m


Cor ♌
Aldeba
In bastza
Rigel
Cap
Os Peg

Aquila
Procyon
Spica
Arctur.
Cand. Dalo.
Lyra
Sirius
Vindem.
Exala.
Cap. Med.
Lu. Hyd.
Os Pēg
Caud. Ce
Cap. ♑
Vesto. ♐
Cauda
Lyra
Sirius
Vindem.
Exala.
Lu. Hyd.
Cap. Med.
Os Pēg
Caud. Ce
Cap. ♑
Vesto. ♐
Aquila
Procyon
Spica
Arctur.
Cand. Dalo.

As for *Example*. Suppoſe I deſire to know when *Cor* ♌ ſhall come to the *Meridian*, what will be his *Altitude* in the *Latitude* of *London* 51° 30′. The height of the *Æquinoctial* is 38° 30′, to which add the Stars *North Declination*, 13° 02′ { 38° 30′ / 13 02 } the Summe is 51° 32′ the *Altitude* required.

So the *Altitude* of the *Spica* ♍ in the *Meridian* will be found to be 28° 57′ in the ſame *Latitude*; for the height of the *Æquinoctial* is 38° 30′; from which take the Stars *South Declination* 9° 33′, the Remainder is 28° 57′.

I have ſo contrived this Inſtrument, that by making two little ſquare holes in the Moveable Plate, the firſt ſheweth you in what *Sign* the Star is, which is abſolutely neceſſary to be known, to judge of the diſtance between the ☉ and the Star (as you have been taught before) and the ſecond ſhews the Magnitude of the Star.

To know at any time propoſed, what Point of the Eccliptick is in the Meridian.

Suppoſe the ☉ to be in the beginning of ♉, I deſire to know what Degree of the *Eccliptick* ſhall be in the *Meridian* at 15′ paſt Five in the *Afternoon*.

I lay the hour given to the *Sun*'s Place, and then I find over againſt the 12 a Clock line of the *Æquinoctial*, 15° 20′ of ♎; and that is the Degree that was then in the *Meridian*.

To know when any of the Planets *ſhall come to the Meridian.*

The *Planets*, becauſe of their continual changing of Place, cannot be ſet fixt in this *Nocturnal*: Nevertheleſs, if at any time you deſire to know their time of coming to the *Meridian*, you muſt look in ſome *Ephemeris* for the Place of the Planet, and according as you find it, ſet it with *Black-Lead* on your Inſtrument, which if it be in *Braſs*, ſhall be eaſily put out. The *Planet* thus ſet, ſhall be as a *Fixed*

Star

Star, and its time of coming to the *Meridian* found out, as that of any of the *Fixed Stars*.

But Note, that if it be the *Moon* that you obſerve, you muſt allow about a degree for every two hours paſt ſince *Noon*; and thus you ſhall have her true Place; for the *Ephemeris* gives you her Place only at *Noon*.

For *Example*. *When will the* Moon *come to the* Meridian *on January the 1ſt.* 168$\frac{4}{5}$?

The ☉ is then in ♑ 22° 5′, and the *Moon* in ♈ 10° 12′. Now placing the *Moon* on my Inſtrument in ♈ 10° 12′, I find that the *Moon* ſhall come to the *Meridian* at a little paſt 5 in the *Afternoon*: and becauſe there are five hours paſt ſince *Noon*, I muſt for theſe five hours allow two degrees and a half to the *Moon's* Place, and ſo ſet it to ♈ 13° 00′; which being done, I ſhall find the *Moon's* true hour of coming to the *Meridian*, and that is at about 5 *h.* 15′ paſt Five in the *Afternoon*.

Hitherto is the Inſtrument general to all thoſe that live on this ſide the *Æquioctial*; and may ſerve to any Intelligent Man that ſhall have *South Declination*.

But beſides, I have made two little Windows in the Moveable Plate, but the Figures of them are Calculated for the *Meridian* of *London*, or any other Place that is under the ſame Latitude of 51° 30′.

The firſt Window ſhews the *Semi-Nocturnal* Arch of the *Star* in Hours and Minutes; and the Uſe of it is to know the time of the *Stars Riſing* and *Setting*, as alſo how long it continues above the *Horizon*.

Firſt. For the *Riſing*, take the *Semi-Nocturnal Arch* from the time of the Stars comiug to the *Meridian*, and the Remainder gives you the time of the Stars Riſing. So the ☉ being in the beginning of ♍, the *Spike* of the *Virgin* comes to the *Meridian* at 9 *h.* 18′ after *Noon*, from which take the Stars ——— 5 11, *Semi-Nocturnal Arch*, there remains ——— 4 07, which is the time of the Stars Riſing in the *Afternoon*.

Secondly, For the Setting, add the *Semi-Nocturnal Arch* to the time of coming to the *Meridian*, and the Summe gives the time of the Stars Setting.

So on the same day, the ☉ being in the beginning of ♎, the *Spike* of the *Virgin* coming to the *Meridian* at 9 *h.* 18′ if you add to it the Star's *Semi-nocturnal Arch*, 5 11′ the Summe is 14 *h.* 29′ past *Noon*, or 2 *h.* 29′ past *Midnight*.

Thirdly, For the time of the Stars being above the *Horizon*, double the *Semi-Nocturnal Arch*, and the Summe is the time of the Star's being above the *Horizon*.

The other Window sheweth the Star's Amplitude in Degrees and Minutes, which is counted from the *East* towards the *North*, when the Star's *Declination* is *North*; and from the *East* to *South*, when the *Declination* is *South*: Where note, that the *Stars* Set at the same Distance from the *West* that they Rise from the *East*.

This *Instrument* was first invented by Mr. *Samuel Foster*, and given to me, drawn upon *Pastboard* by his own hand, which is still in my Power; but the Additions to it were put in by an Ingenious Gentleman of the *French* Nation, and by him drawn in *Brass*, which I received from him, and will keep for his Sake.

The following Table is made to insert all the Stars expressed there according to their *Right Ascensions*, which is fourfold as great as the true is, the Nature of the Instrument requiring it to be so; because the *Æquinoctial*, which should be divided into twenty four hours, is divided but into six hours.

A Table

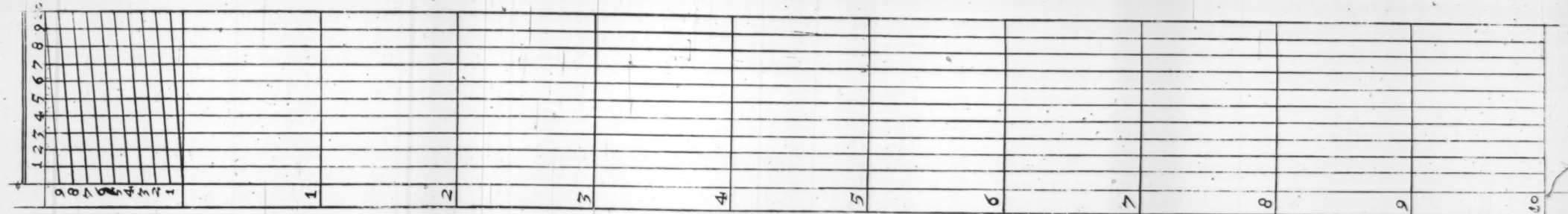
A Table

	A. R.	AsRec. 4.	Decli.	Semi-Diurnal Arch.	Amplit.
	° ′		° ′	h. mi.	
Lucid. Comæ Beren. ♎	182 45	731 00	30 06	8 48	53 30
Lucid. Lyræ ♑.	276 42	1106 48	38 32	24 00	00 00
Syrius. ♐.	98 00	392 00	16 15	4 33	26 43
Vindemiatrix. ♍.	191 53	767 32	2 35	7 05	20 30
Spica Virginis. ♍.	197 23	789 32	9 33	5 11	15 27
Procyon. ♌.	110 57	443 48	6 00	6 30	9 40
Aquila. ♑.	294 06	1176 24	8 07	6 41	13 07
Luc. cap. Arietes. ♈.	27 38	110 32	22 03	8 04	37 05
Arcturus. ♏.	210 34	842 16	20 49	7 55	34 49
Cauda Delphin. ♒.	304 30	1218 00	10 14	6 54	16 35
Auftra lanx ♎. ♏.	218 37	874 28	14 45	7 17	24 09
Cap. Medus. ♉.	42 15	169 00	39 47	12 00	00 00
Bo. lanx. ♎. ♏.	225 16	901 04	8 14	5 18	13 18
Luc. Hydr. ♌.	138 16	553 04	7 22	5 22	11 53
Luc. Pleiad. ♉.	52 26	209 44	23 10	8 11	39 12
Luc. Coron. Sep. ♏.	230 31	922 4	27 45	8 46	48 25
Os Pega. ♒.	322 28	1289 52	8 31	6 44	13 46
Med. nox. col. Serp: ♏	232 27	929 48	7 25	6 38	11 52
Bo. Fron. Scor. ♏.	237 02	948 08	18 57	4 18	31 27
Antares ♐. cor ♏.	242 50	971 20	25 42	3 30	44 00
Cor Leonis. ♌.	148 08	592 32	13 02	7 08	21 15
Luc. colli Leonis. ♌.	150 51	603 24	21 21	7 58	35 48
Luc. colli Peg. ♑.	336 30	1346 00	09 10	6 47	14 50
In baſi Crater. ♍.	161 10	644 40	16 33	4 32	27 14
Marchab. Pega. ♓.	342 30	1370 00	13 37	7 11	22 13
Rigel. ♎.	75 07	300 28	8 33	5 16	13 49
Sin. Hum. Orion. ♊.	77 17	309 08	6 03	6 31	9 45
Cing. Orion. ♊.	80 18	321 12	1 24	5 54	2 15
Caput Ophiuci. ♐.	260 16	1041 04	12 49	7 06	20 52
Cauda Leonis. ♍.	173 28	693 52	16 13	7 26	26 39
Seq. Hum. Orion. ♊.	84 48	339 12	7 20	6 37	11 50
Cuſpis Sagit. ♐.	266 00	1064 00	30 22	2 50	54 18
Cap. Andromed. ♓.	358 16	1433 04	27 28	8 44	47 48
Extrem. ala Pegas. ♓.	359 30	1438 00	13 32	7 10	22 05
Aldeban Tauri. ♊.	64 43	258 52	15 53	7 24	26 05

		The 5.		10		15		20		25	
		°	′	°	′	°	′	°	′	°	′
♈	♎	00	00	18	20	36	44	55	12	73	48	92	36
♉	♏	111	36	130	48	150	16	170	04	190	08	210	32
♊	♐	231	12	252	08	273	24	294	52	316	28	338	12
♋	♑	360	00	381	48	403	32	425	08	446	36	467	48
♌	♒	488	48	509	28	529	52	549	56	569	44	589	12
♍	♓	608	24	627	24	646	12	664	48	683	16	701	40

FINIS.





In the Diagonall Scale you have London foot Divided into 1000 Equal parts, Whereof

France

Paris Foot is 1:068
Lions Ell 3:976
Bolonie Ell 2 076

The XVII Provinces

Amsterdam foot	0:942
Ell	2:269
Antwerp foot	0:940
Brill foot	1:103
Dort foot	1:184
Leyden foot	1:133
Ell	2:260
Lorain foot	0:958
Mecalin foot	0:919
Middleburg foo	0 991

Germany

Strasburg foot	0:920
Bremen foot	0:964
Cologne foot	0:954
Francfort foot	0:948
Meniain foot	
Ell	1:826
Hamburg Ell	1 905
Leipsig Ell	2:260
Lubeck Ell	1 903

Noremberg foot	1:006
Ell	2:227
Bavaria foot	0:954
Vienna foot	1 053

Spain & Portugall

Spainsh or Castil palm	751
Spanish Vare or rod	3:004
Spanish foot	1:001
Lisbon Vare	2:750
Gibralter Vare	2:760

Toledo foot	0:899
Vare	2:685

Italy

Roman foot on the Monum^t of Cosutius	0:967
of Statelius	0 972
Roman foot for building	0 722
m^r 10 make y^e Cauna	
Bononia foot	1 204
Ell	2 113

Bononian Perch m^r 500 to a Mile	12:040
Florence Brace or	1:917
Naples Palm	0:861
Brace	2:100
Cauna	6:880
Genoa Palm	0 850
Mantua foot	1 569
Milan Calamus	6:544
Parma Cubit	1:860
Venice foot	1 162

Other Places

Danzick foot	0:944
Ell	1:903
Copenhagen foot	0:965
Prague foot	1:026
Riga foot	1:831
China cubit	1 016
Turin foot	1 062
Cairo cubit	1 824
Persian Arash	3 197

Turkish Pike at Constantinop: the greater	2:200
The Greek foot	1 007
Moutons universal foot	0 675

A Pendulum of w^ch length will Vibrate 132 times in a minute, A Pendulum of 3 foot 268 parts long will Vibrate 60 times in a minut

Ex: per me Jonas Moor

Tabula Aſcenſionum Obliquarum ad Latitudinem 51 *deg.* 00 *min.*

° ′	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
0	0 00	13 21	30 46	57 31	95 10	137 33	180 00	222 27	263 50	302 29	329 14	346 39
1	0 25	13 50	31 29	58 37	96 33	138 59	181 24	223 52	266 12	303 34	329 56	347 08
2	0 50	14 20	32 13	59 44	97 56	140 24	182 49	225 17	267 34	304 38	330 38	347 37
3	1 16	14 50	32 57	60 51	99 19	141 50	184 03	225 43	268 56	305 41	331 19	348 05
4	1 41	15 20	33 42	61 59	100 42	143 15	185 38	228 05	270 18	306 44	331 59	348 34
5	2 07	15 50	34 27	63 08	102 06	144 40	187 03	229 34	271 39	307 46	332 38	349 02
6	2 32	16 21	35 13	64 18	103 30	146 06	188 27	230 59	272 59	308 47	333 16	349 30
7	2 58	16 53	36 00	65 29	104 54	147 31	189 52	232 25	274 19	309 47	333 54	349 58
8	3 24	17 24	36 48	66 40	106 18	148 56	191 16	233 52	275 39	310 46	334 32	350 25
9	3 50	17 56	37 36	67 52	107 42	150 21	192 41	235 17	276 58	311 44	335 10	350 53
10	4 16	18 28	38 25	69 04	109 07	151 46	194 06	236 42	278 17	312 42	335 47	351 20
11	4 42	19 01	39 15	70 17	110 32	153 11	195 30	238 08	279 35	313 39	336 23	351 47
12	5 08	19 34	40 05	71 30	111 57	154 36	196 55	239 33	280 52	314 35	336 59	352 14
13	5 34	20 07	40 56	72 44	113 22	156 01	198 20	240 58	282 10	315 30	337 35	352 41
14	6 00	20 40	41 48	73 59	114 47	157 26	199 45	242 23	283 28	316 25	338 11	353 08
15	6 26	21 14	42 41	75 15	116 12	158 50	201 10	243 48	284 45	317 19	338 46	353 34
16	6 52	21 49	43 35	76 32	117 37	160 15	202 34	245 13	286 01	318 12	339 20	354 00
17	7 19	22 25	44 30	77 50	119 02	161 40	203 59	246 38	287 16	319 04	339 53	354 26
18	7 46	23 01	45 25	79 08	120 27	163 05	205 24	248 03	288 30	319 55	340 25	354 52
19	8 13	23 37	46 21	80 25	121 52	164 30	206 49	249 28	289 43	320 45	340 59	355 18
20	8 42	24 13	47 18	81 43	123 18	165 54	208 14	250 53	290 56	321 35	341 32	355 44
21	9 07	24 50	48 16	83 02	124 43	167 19	209 39	252 18	292 08	322 24	342 04	356 10
22	9 35	25 28	49 14	84 21	126 09	168 44	211 04	253 42	293 20	323 12	342 36	356 36
23	10 02	26 06	50 13	85 41	127 35	170 08	212 29	255 06	294 31	324 00	343 07	357 02
24	10 30	26 41	51 13	87 01	129 01	171 32	213 54	256 30	295 42	324 47	343 39	357 28
25	10 58	27 22	52 14	88 21	130 26	172 57	215 20	257 54	296 52	325 33	344 10	357 53
26	11 26	28 01	53 16	89 42	131 52	174 22	216 45	259 18	298 01	326 18	344 40	358 19
27	11 55	28 41	54 19	91 04	133 17	175 47	218 10	260 41	299 09	327 03	345 10	358 44
28	12 23	29 22	55 22	92 26	134 43	177 11	219 35	262 04	300 16	327 47	345 40	359 10
29	12 52	30 04	56 26	93 48	136 08	178 36	221 01	263 27	301 23	328 31	346 10	359 35
30	13 21	30 46	57 31	95 10	137 33	180 00	222 27	264 50	302 29	329 14	346 39	360 00

Tabula Aſcenſionum Obliquarum ad Latitudinem 51 *deg.* 30 *min.*

o ′	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
0	0 00	13 04	30 12	56 48	94 30	137 15	180 00	222 45	265 24	303 12	329 48	346 56
1	0 24	13 32	30 54	57 54	95 08	138 42	181 25	224 10	263 47	304 17	330 29	347 25
2	0 49	14 01	31 38	59 01	97 24	140 08	182 50	225 36	268 9	305 21	331 11	347 53
3	1 14	14 30	32 21	60 08	98 46	141 34	184 15	227 02	269 32	306 24	331 51	348 21
4	1 39	15 01	33 05	61 15	100 10	143 00	185 40	228 43	270 54	307 27	332 39	348 49
5	2 04	15 30	33 50	62 25	101 35	144 26	187 05	229 54	272 16	308 29	333 09	349 16
6	2 29	16 00	34 35	63 35	102 59	145 52	188 30	231 20	273 37	309 30	333 47	349 44
7	2 54	16 31	35 22	64 46	104 23	147 1	189 56	232 46	274 57	310 30	334 25	350 11
8	3 19	17 02	36 08	65 57	105 45	148 43	191 21	234 13	276 17	311 29	335 2	350 38
9	3 45	17 33	36 37	67 10	107 13	150 09	192 45	235 39	277 36	312 27	335 40	351 05
10	4 10	18 05	37 46	68 22	108 38	151 34	194 12	237 05	278 56	313 21	336 17	351 32
11	4 36	18 37	38 35	69 35	110 03	153 00	195 37	238 32	280 14	314 21	335 52	351 58
12	5 01	19 10	39 26	70 49	111 29	154 25	197 02	239 57	281 32	315 16	337 27	352 25
13	5 26	19 42	40 16	72 03	112 54	155 51	198 28	241 23	282 51	316 11	338 2	352 51
14	5 52	20 14	41 08	73 19	114 21	157 16	199 53	242 49	284 8	317 6	338 38	353 17
15	6 17	20 48	42 01	74 35	115 46	158 44	201 16	244 14	285 25	317 59	339 12	353 43
16	6 43	21 22	42 54	75 52	117 11	160 07	202 44	245 39	286 41	318 52	339 46	354 8
17	7 09	21 58	43 49	77 07	118 37	161 32	204 09	247 6	287 57	319 44	340 13	354 34
18	7 35	22 33	44 44	78 28	120 03	162 58	205 35	248 31	289 11	320 34	340 50	354 59
19	8 02	23 03	45 39	79 46	121 25	164 23	207 00	249 57	290 25	321 25	341 23	355 24
20	8 28	23 43	46 25	81 04	122 55	165 48	208 25	251 22	291 38	322 14	341 55	355 50
21	8 55	124 20	47 33	82 24	124 21	167 14	209 51	352 47	292 50	323 3	342 27	356 15
22	9 22	24 58	48 31	83 43	125 47	168 39	211 17	254 12	294 3	323 52	342 58	356 41
23	9 49	25 35	49 30	85 03	127 14	170 04	212 43	255 37	295 14	324 38	343 29	357 6
24	10 16	26 13	50 30	86 23	128 40	171 30	214 08	257 1	296 25	325 25	344 0	357 31
25	10 40	26 51	51 31	87 44	130 06	172 54	215 34	258 25	297 35	326 10	344 32	357 36
26	11 11	27 30	52 33	89 05	131 32	174 20	217 00	259 59	298 44	326 54	344 59	358 21
27	11 39	28 09	53 36	90 23	132 58	175 45	218 26	261 14	299 52	327 39	345 35	358 46
28	12 07	28 49	54 39	91 51	134 24	177 10	219 52	262 36	300 59	328 22	345 59	359 11
29	12 35	29 31	55 43	93 13	135 50	178 35	221 18	264 1	302 6	329 6	346 28	359 36
30	13 04	30 12	56 48	94 36	137 15	180 00	222 45	265 24	303 12	329 48	346 56	360 0

Tabula Ascensionum Obliquarum ad Latitudinem 52 *deg.* 00 *min.*

°	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
0	00 00	12 48	29 42	56 1	94 06	137 0	180 9	223 0	265 54	303 4	330 15	347 12
1	00 24	13 15	30 24	57 17	95 30	138 2	181 25	224 26	267 17	304 51	330 55	347 40
2	00 48	13 45	31 7	58 24	96 54	139 5	182 51	225 52	268 40	305 55	331 35	348 7
3	1 13	14 14	31 50	59 31	98 18	141 20	184 16	227 15	270 3	307 1	332 19	348 35
4	1 37	14 43	32 34	60 39	99 42	142 47	185 42	228 45	271 26	308 4	332 58	349 2
5	2 02	15 12	33 18	61 48	101 5	144 13	187 8	230 12	272 48	309 6	333 37	349 29
6	2 26	15 42	34 3	62 58	102 32	145 40	188 33	231 38	274 9	310 7	334 15	349 55
7	2 51	16 13	34 49	64 09	103 57	147 6	189 59	233 5	275 49	311 7	334 52	350 23
8	3 15	16 43	35 36	65 20	105 22	148 32	191 25	234 32	276 50	312 6	335 25	350 49
9	3 40	17 14	36 24	66 32	106 47	149 52	192 51	235 52	278 10	313 4	336 6	351 16
10	4 5	17 45	37 12	67 45	108 12	151 24	194 17	237 25	279 30	314 1	336 42	351 42
11	4 30	18 16	38 1	68 55	109 38	152 50	195 42	238 52	280 49	314 57	337 17	352 8
12	4 55	18 48	38 51	70 13	111 4	154 16	197 8	240 18	282 8	315 52	337 52	352 33
13	5 20	19 20	39 42	71 28	112 30	155 42	198 34	241 48	283 26	316 47	338 25	352 59
14	5 45	19 52	40 34	72 44	113 56	157 8	200 0	243 11	284 43	317 41	339 1	353 25
15	6 10	20 25	41 26	74 0	115 23	158 54	201 26	244 37	286 00	318 32	339 35	353 50
16	6 35	20 59	42 19	75 17	116 49	160 0	202 52	246 4	287 19	319 26	340 8	354 15
17	7 1	21 34	43 13	76 34	118 15	161 26	204 18	247 30	288 32	320 18	340 40	354 40
18	7 26	22 08	44 8	77 52	119 42	162 52	205 44	248 56	289 47	321 9	341 11	355 5
19	7 52	22 43	45 3	79 11	121 8	164 18	207 10	250 22	291 1	321 59	341 41	355 30
20	8 18	23 18	45 59	80 30	122 35	165 43	208 36	251 48	292 15	322 48	342 15	355 55
21	8 44	23 54	46 56	81 50	124 2	167 9	210 2	253 13	293 28	323 36	342 40	356 20
22	9 11	24 31	47 54	83 10	125 28	168 35	211 28	254 38	294 40	324 21	343 17	356 45
23	9 37	25 08	48 53	84 31	126 55	170 1	212 54	256 3	295 51	325 11	344 18	357 9
24	10 4	25 45	49 53	85 51	128 22	171 27	214 20	257 28	297 2	325 57	344 18	357 34
25	10 31	26 23	50 54	87 12	129 48	172 52	215 47	253 53	298 12	326 42	344 48	357 58
26	10 58	27 2	51 56	88 33	131 15	174 18	217 13	260 18	299 21	327 26	345 17	358 23
27	11 25	27 41	52 59	89 5	132 41	175 44	218 40	261 42	300 29	328 10	345 46	358 47
28	11 53	28 21	54 2	91 2	134 8	177 9	220 6	263 6	301 36	328 53	346 15	359 12
29	12 20	29 01	55 6	92 43	135 34	178 35	221 33	264 30	302 43	329 36	346 44	359 36
30	12 48	29 42	56 11	94 06	137 00	180 9	223 0	265 54	303 49	330 18	347 12	360 0

Tabula Ascensionum Obliquarum ad Latitudinem 53 *deg.* 00 *min.*

° ′	♈	♉	♊	♋	♌	♍	♎	♏	♐	♑	♒	♓
0 0	0 0	12 14	28 34	54 46	92 58	136 26	180 0	223 34	267 2	305 14	331 26	347 46
1	0 23	12 41	29 11	55 52	94 23	137 54	181 26	225 1	268 27	306 20	332 6	348 13
2	0 40	13 8	29 57	56 59	95 48	139 22	182 53	226 29	269 51	307 25	332 45	348 40
3	1 09	13 36	30 39	58 6	97 13	140 49	184 20	227 56	271 15	308 28	333 24	349 6
4	1 32	14 4	31 22	59 14	98 38	142 17	185 47	229 24	272 38	309 30	334 2	349 32
5	1 56	14 32	32 6	60 23	100 4	143 44	187 14	230 52	274 0	310 31	334 40	349 58
6	2 19	15 1	32 51	61 33	101 30	145 12	188 40	232 19	275 22	311 31	335 17	350 24
7	2 43	15 30	33 36	62 44	102 56	146 39	190 7	233 47	276 44	312 30	335 53	350 50
8	3 6	15 59	34 22	63 56	104 22	148 7	191 34	235 15	278 5	313 29	336 29	351 15
9	3 30	16 29	35 8	65 9	105 48	149 34	193 1	236 43	279 26	314 27	337 4	351 40
10	3 54	16 59	35 55	66 22	107 15	151 1	194 28	238 11	280 47	315 24	337 39	352 5
11	4 17	17 29	36 43	67 36	108 42	152 29	195 55	239 19	282 7	316 21	338 13	352 30
12	4 41	18 0	37 32	68 51	110 9	153 56	197 22	241 6	283 26	317 16	338 47	352 55
13	5 5	18 31	38 22	70 6	111 36	155 23	198 49	242 34	284 45	318 10	339 20	353 19
14	5 29	19 2	39 11	71 22	113 4	156 50	200 16	244 1	286 3	319 3	339 53	353 43
15	5 53	19 34	40 5	72 39	114 32	158 17	201 43	245 28	287 21	319 55	340 26	354 7
16	6 17	20 7	40 57	73 57	115 59	159 44	203 10	246 56	288 38	320 47	340 58	354 31
17	6 41	20 40	41 50	75 15	117 25	161 11	204 37	248 24	289 54	321 38	341 29	354 55
18	7 5	21 13	42 44	76 34	118 54	162 38	206 4	249 51	291 9	322 28	342 0	355 19
19	7 30	21 47	43 39	77 53	120 21	164 5	207 31	251 18	292 24	323 17	342 31	355 43
20	7 55	22 21	44 36	79 13	121 49	165 32	208 59	252 45	293 38	324 5	343 1	356 6
21	8 20	22 56	45 33	80 34	123 17	166 59	210 26	254 12	294 51	324 52	343 31	356 30
22	8 45	23 31	46 31	81 55	124 45	168 26	211 53	255 38	296 4	325 38	344 1	356 54
23	9 10	24 7	47 30	83 16	126 13	169 53	213 21	257 4	297 16	326 24	344 30	357 17
24	9 36	24 43	48 29	84 38	127 41	171 20	214 48	258 30	298 27	327 9	344 59	357 41
25	10 2	25 20	49 29	86 0	129 8	172 46	216 16	259 56	299 37	327 54	345 28	358 4
26	10 28	25 58	50 30	87 22	130 36	174 13	217 43	261 22	300 46	328 38	345 56	358 28
27	10 54	26 36	51 32	88 45	132 4	175 40	219 11	262 47	301 54	329 21	346 24	358 51
28	11 20	27 15	52 34	90 9	133 31	177 7	220 38	264 12	303 1	330 3	346 52	359 14
29	11 47	27 53	53 40	91 33	134 59	178 34	222 6	265 37	304 8	330 45	347 19	359 37
30	12 14	28 34	54 46	92 58	136 26	180 0	223 34	267 2	305 14	331 26	347 46	360 0

complete, by comparison with
another copy FJ
1900 June 27